Geographic Information Systems
Master Plan

FY 2001 - 2002

Cooperatively Developed By

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Mission Statement

The GIS Division shall serve as the coordinating body for mapping and data development for departments within the City of Salisbury. The GIS Division shall be committed to the development of accurate and timely data about the City of Salisbury and the surrounding region. Each department shall utilize GIS data as applicable in order to provide a continuing level of service to the citizens of Salisbury. The GIS Division shall be a central point of contact for citizens to quickly and easily access accurate and current geographic information.

Introduction

The development of a Geographic Information System (GIS) Master Plan is a long and detailed process. As such, the *Local Government GIS Development Guide* has served as a valuable resource in organizing this initial GIS Master Plan for the City of Salisbury. This plan shall set forth the procedures and methods used for planning the GIS, evaluating potential data sources and data needs, evaluating hardware and software solutions, building the GIS data base, developing GIS applications, and planning for the long term maintenance of the GIS system and the data.

The underlying philosophy of this entire Master Plan is to concentrate on the GIS data. The importance of data is commonly overlooked, despite being both the most expensive and the most integral part of an enterprise GIS. Data must be collected, stored, maintained and archived in such a manner as to ensure continued availability and utility to users of the enterprise GIS.

Basic Definition of a Geographic Information System (GIS)

According to ESRI, a geographic information system (GIS) is defined as an organized collection of computer hardware, software, geographic data, and personnel. This system is designed to efficiently capture, store, update, manipulate, analyze, and display the geographically referenced information.

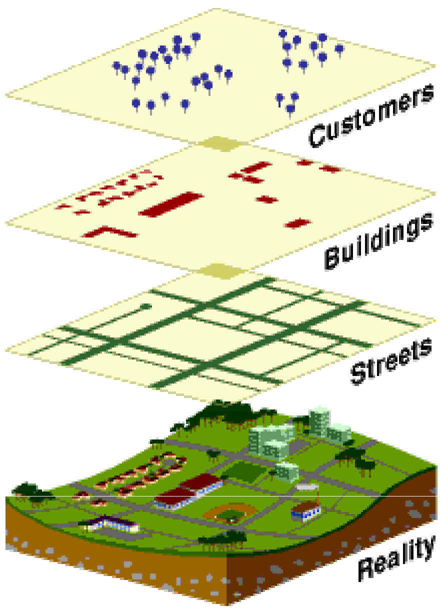
A GIS is <u>not</u> maps, but it is...

- A method of organizing data

- Geographic data (maps, images, drawings, etc.)

- Descriptive data (databases)

- A method of distributing data
- A method of analyzing data
- A method of visualizing data



The value of a GIS is found after the development of large amounts of data. Unlike other software applications, where a user can begin to utilize it immediately upon installation, a GIS requires that extensive databases be available before it becomes useful.

GIS is comprised of five key elements: hardware, software, data, people and methods.

Hardware is the computer on which a GIS operates. Peripheral equipment such as plotters, printers, scanners and digitizers are often a large component of the GIS.

GIS software provides the functions and tools needed to create, manipulate, analyze, manage, display and output geographic data.

Data is the key component of a GIS. Data can be collected and created in-house, or purchased from a commercial data provider. Some examples of data are: Roads, Parcels, Municipal Boundaries, School Districts, Census Tracts, Parks, Water Bodies, Landmarks, Historic Places, Bus Routes, Rail Lines, Major Employers, Schools, Wetlands, Demographics, Incidences of Disease/Illness, Traffic Counts, Libraries, Watersheds, Hazardous Material Locations, Geologic data, etc.

People manage the system and develop plans to apply it to real world problems. GIS users range from technical specialists who design and maintain the system, to those who use it to help them perform their everyday work.

A successful GIS needs well-designed methods to function efficiently. (whether it be collecting and maintaining data on a timely basis, or automating analysis done on a regular basis).

More on "What is Geographic Information System?"...

"A geographic information system is a facility for preparing, presenting, and interpreting facts that pertain to the surface of the earth. This is a broad definition . . . a considerably narrower definition, however, is more often employed. In common parlance, a geographic information system or GIS is a configuration of computer hardware and software specifically designed for the acquisition, maintenance, and use of cartographic data." C. Dana Tomlin - **Geographic Information Systems and Cartographic Modeling** (Englewood Cliffs, NJ: Prentice-Hall,1990), page xi

"A geographic information system (GIS) is an information system that is designed to work with data referenced by spatial or geographic coordinates. In other words, a GIS is both a database system with specific capabilities for spatially-referenced data, as well [as] a set of operations for working with data . . . In a sense, a GIS may be thought of as a higher-order map." Jeffrey Star and John Estes - **Geographic Information Systems: An Introduction** (Englewood Cliffs, NJ: Prentice-Hall, 1990), page 2-3

A GIS is "an organized collection of computer hardware, software, geographic data, and personnel designed to efficiently capture, store, update, manipulate, analyze, and display all forms of geographically referenced information." - **Understanding GIS: The ARC/INFO Method** (Redlands, CA: Environmental System Research Institute, 1990), page 1.2

"GIS is a special-purpose digital database in which a common spatial coordinate system is the primary means of reference. Comprehensive GIS require a means of:

- Data input, from maps, aerial photos, satellites, surveys, and other sources
- Data storage, retrieval, and query
- Data transformation, analysis, and modeling, including spatial statistics
- Data reporting, such as maps, reports, and plans

Three observations should be made about this definition:

First, GIS are related to other database applications, but with an important difference. All information in a GIS is linked to a spatial reference. Other databases may contain locational information (such as street addresses, or zip codes), but a GIS database uses geo-references as the primary means of storing and accessing information.

Second, GIS integrates technology. Whereas other technologies might be used only to analyze aerial photographs and satellite images, to create statistical models, or to draft maps, these capabilities are all offered together within a comprehensive GIS.

Third, GIS, with its array of functions, should be viewed as a process rather than as merely software or hardware. GIS are for making decisions. The way in which data is entered, stored, and analyzed within a GIS must mirror the way information will be used for a specific research or decision-making task. To see GIS as merely a software or hardware system is to miss the crucial role it can play in a comprehensive decision-making process." - Kenneth E. Foote and Margaret Lynch, The Geographer's Craft Project, Department of Geography, University of Texas at Austin

What Do Governments Do with GIS?

The use of geographic information systems by local government falls into five major categories:

- Browse
- Simple display (automated mapping)
- Query and display
- Map analysis
- Spatial modeling.

Browse

This function is equivalent to the human act of reading a map to find particular features or patterns. Browsing usually leads to identification of items of interest and subsequent retrieval and manipulation by manual means. For single maps, or relatively small areas, the human brain is very efficient at browsing. However, as data volumes increase, automated methods are required to effectively extract and use information from the map.

Simple Display

This GIS function is the generation of a map or diagram by computer. Such maps and diagrams are often simple reproduction of the same maps used in a previous manual oriented GIS environment. Examples of this type of use are preparation of a 1:1000-scale town map, a sketch of an approved site plan, maps of census data, etc.

Query And Display

This function supports the posing of specific questions to a geographic database, with the selection criteria usually being geographic in nature. A typical simple query would be: "draw a map of the location of all new residential units built during 1989." A more complex query might be: "draw a map of all areas within the town where actual new residential units built in 1989 exceeds growth predictions." Such a query could be part of a growth management activity within the town.

Queries may be in the form of regular, often asked questions or may be ad hoc, specific purpose questions. The ability to respond to a variety of questions is one of the most useful features of a GIS in its early stages of operation. In the long run, other more sophisticated applications of the GIS may have a higher value or benefit, but to achieve these types of benefits, users must be familiar with the GIS and its capabilities. Such familiarization is achieved through the use of a GIS for the simpler tasks of query and display.

Map Analysis (Map Overlay)

This involves using the analytical capabilities of GIS to define relationships between layers of spatial data. Map analysis is the super-imposition of one map upon another to determine the characteristics of a particular site (e.g., combining a land use map with a map of flood prone areas to show potential residential areas at risk for flooding).

Map analysis (often termed overlay or topological overlay) was one of the first real uses of GIS. Many government organizations, particularly those managing natural resources, have a need to combine data from different maps (vegetation, land use, soils, geology, ground water, etc.). The overlay function was developed to accomplish the super-imposition of maps in a computer.

The data are represented as polygons, or areas, in the GIS data base, with each type of data recorded on a separate "layer." The combination of layers is done by calculating the logical intersection of polygons on two or more map layers.

In addition to combining multiple "layers" of polygon-type data, the map overlay function also permits the combination of point data with area data (point-in-polygon). This capability would be very useful in a town for combining street addresses (from the Assessor's files) with other data such as parcel outlines, census tract, environmental areas, etc. Many facility siting problems, location decisions, and land evaluation studies have successfully used this procedure in the past.

Spatial Modeling

This application is the use of spatial models or other numerical analysis methods to calculate a value of interest. The calculation of flow in a sewer system is an example of spatial modeling. Spatial modeling is the most demanding use of a GIS and provides the greatest benefit. Most spatial modeling tasks are very difficult to perform by hand and are not usually done unless a computerized system, such as a GIS, is available. These models allow engineers and planners to evaluate alternate solutions to problems by asking "what if" type questions.

A spatial model can predict the result expected from a decision or set of decisions. The quality of the result is only as good as the model, but the ability to test solutions before decisions have to be made usually provides very useful information to decision makers. Once again, this type of use of a GIS will evolve over time, as the GIS is implemented and used.

In general, geographic information in local government is used to:

- Respond to public inquiries,
- Perform routine operations such as application reviews and permit approvals, and
- Provide information on the larger policy issues requiring action by the town board.

These are typical local government activities which benefit from a geographic information system. The development of GIS will facilitate the present geographic information handling tasks and should lead to the development of additional applications of benefit to the local government.

Excerpted from Geographic Information System Development Guides - Needs Assessment New York State Archives and Records Administration.

What is the Relationship between CAD and GIS?

Computer Aided Design (CAD)

A closely related computer capability is a CAD system (computer aided design). CAD systems are used to prepare detailed drawings and plans for engineering and planning applications. While CAD systems functions are different from GIS functions, many commercial CAD products have some of the functionality normally found in a GIS. There are, however, significant differences between a CAD system and a GIS, mainly in the structure of the database. There may be some need for CAD-type capabilities in a particular local government, so this forms another category of use.

At the 1998 Autodesk Design World, Bill Wittreich of Wittreich & Associates, gave a presentation titled **Beyond CAD into GIS**. What follows is paraphrased from a portion of his talk.

AutoCAD Map adds GIS features to the base AutoCAD product and, as such, these features help define the difference between CAD and GIS. In short, the difference between CAD and GIS is the difference between a drawing and a spatial database.

Modeling

CAD models things in the real world. GIS models the world itself. Therefore, GIS uses geographic coordinates systems and world map projections while CAD coordinates are relative to the object being modeled and are not usually relative to any particular place on earth.

Objects

CAD objects include lines, circles, arcs, text, etc. using layers, blocks, internal data, and dimensions. CAD objects don't know about each other, even though they may touch or overlap. GIS objects know about each other:

- GIS understands networks. For instance, the lines describing streets are related to one another.
- GIS understands enclosed areas (polygons) and their associativity with other objects.
- GIS understands connectivity, conductivity, and associativity which enables spatial analysis.
- GIS adds topology

The primary difference between CAD and GIS is topology. GIS has it, CAD doesn't. In a CAD environment, the objects (lines, polylines, points, etc.) have no relationships between them. Topology brings these objects together into logical groups to form real world models.

Node topology allows spatial analysis, such as buffering to determine other objects within a certain range.

Network topology allows modeling of direction and resistance. Path tracing finds the fastest or best route. Flood tracing determines the maximum flow from a given point and network resistance. As with node topology, buffer analysis can be applied to networks too.

Polygon topology enables polygons to have relationships. Polygons also have centroids which can be used to hold data relevant to the polygons. Polygon spatial analysis includes overlay analysis such as determining parcels in a floodplain. Polygons can be "dissolved" using attributes with common values to remove interior lines, in effect aggregating polygons with in the same class.

Topology and spatial analysis differentiate GIS from CAD.

Data Management

GIS separates object storage from object display, combining data from multiple sources into a virtual data warehouse. That data can then be used in any number of separately defined analyses or presentations. CAD systems carry baggage such as line color, line width, etc. that is not relevant to the data itself.

GIS systems are usually disk-based and can model larger areas than CAD implementations which are usually memory-based. For instance, CAD files are typically smaller, such as product designs as compared to regional, state, or even world models in GIS.

The Trend

While the distinction between CAD and GIS is gray now, as features are added to CAD systems, the distinction will blur even more.

Seven Keys that Guarantee the Success of Your GIS

1. Master Plan

- ✓ A vital "first-step" for local, state, and federal agencies.
- ✓ Learn how to jump-start your existing GIS initiative.
- ✓ Learn how to share the plan to guarantee organization-wide support.
- ✓ Identify optimal uses of GPS and web-based tools.
- ✓ Identify funding opportunities.

2. Coordination

- ✓ The most critical key to success!
- ✓ Identify the best solution for coordinating your GIS.
- ✓ Organize your GIS efforts to serve all departments.
- ✓ Identify where to locate the coordination effort.
- ✓ What are the characteristics of an effective coordination strategy?

3. Quick Success

- ✓ The first year will determine the success of your project.
- ✓ Guarantee support from managers, directors, and elected officials.
- ✓ Identify and target "high impact" projects.
- ✓ How to "showcase" your successes!
- ✓ Leverage press and media coverage.
- ✓ Show successes and progress continually.

4. Educate

- ✓ How to best educate your entire organization?
- ✓ Guarantee support throughout your organization.
- ✓ How to make GIS indispensable for your agency.
- ✓ Outsourcing vs. in-house education.
- ✓ Select the best tools i.e. newsletters, user groups, and conferences.

5. Easy to Use

- ✓ How to deliver the right tools to the right person!
- ✓ Remove obstacles to GIS use.
- ✓ Task-specific solutions.
- ✓ How to make GIS useful and easy to use.
- ✓ New GIS tools to ensure enterprise-wide use.
- ✓ GIS applications with little training.

6. Enterprise Wide

- ✓ Enterprise-wide usage – the litmus test for a truly successful GIS.
- ✓ As widely used as a word processor.
- ✓ GIS on everyone’s desktop!
- ✓ Users in all departments.
- ✓ How to harness the power of GIS.
- ✓ How to turn raw data into meaningful information.

7. Benefits vs. Costs

- ✓ Quantify the benefits of GIS.
- ✓ Show how your GIS saves lives, time, and money!
- ✓ Guarantee continued support from organization leaders and elected officials.
- ✓ Identify revenue-generating options.
- ✓ Real world examples.

From Curtis Hinton, Geographic Technologies Group, Inc.

Hardware

The City of Salisbury is fortunate to have a policy of replacing computers every three years. This enables staff to work quickly and efficiently on up-to-date machines. The Information Technology Division of the Finance Department has also recognized that computers utilized for GIS purposes typically need more memory, a better video card, and a larger monitor. The specifications for a GIS computer for fiscal year 2001-2002 are as follows:

Hard Drive:	Western Digital 20GB 7200 RPM
Memory:	512 MB (PC133 SDRAM)
Monitor:	OptiQuest 21 inch 1600 x 1280
Operating System:	Windows 2000 Professional
Processor:	AMD Athlon 1GHZ 266 Front Side Bus
Video Card:	ATI 64MB Radeon Double Data Rate AGP

Software

The City of Salisbury has standardized on the Environmental Systems Research Institute, Inc. (ESRI) family of products for its geographic information systems software. ArcInfo and ArcIMS are on a yearly maintenance contract. Upgrades for ArcView are purchased on an as-needed basis. The following number of licenses is held by the City of Salisbury:

Software Name	Number of Licenses	Renewal Date
ArcInfo	4	09-11-2002
ArcPress	1	09-11-2002
COGO	2	09-11-2002
Network	2	09-11-2002
Spatial Analyst	2	09-11-2002
ArcIMS	2	09-11-2002
ArcView	33	Last upgraded 07-16-2001
	(13 for training purposes)	
Network	2	Need to be upgraded
Spatial Analyst	2	Need to be upgraded

The City of Salisbury has standardized on the AutoDesk, Inc. family of products for its computer-aided drafting software. All AutoDesk products are on a yearly subscription service. The following number of licenses is held by the City of Salisbury:

Software Name	Number of Licenses	Renewal Date
Land Development Desktop	9	10-31-2002
CAD Overlay	8	10-31-2002
Civil Design	8	10-31-2002
Survey	8	10-31-2002
AutoCAD	2	10-31-2002

All departments/divisions using geographic information systems or computer-aided drafting software are requested to coordinate their purchases through the GIS Division.